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An Experimental Study on Use of Gypsum Powder and Agro Waste As Panel For Noise Insulation

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ABSTRACT
In this project the aim of the research is to produce a noise insulation panel which is made out of rice straw and Gypsum Powder, because due to rapid growth in urbanization. Mechanization of work process has led to noise pollution. Therefore, using noise reduction panels in the building elements could considerably help to minimize the noise and provide a comfortable working atmosphere. Nowadays people demand for a better working environment. Some of the commercial noise insulating materials available in the market are expensive and may not be eco-friendly which may cause health issues when people are exposed with these materials.
If a product made by combination of naturally occurring mineral and Agro waste and used as noise-reducing panels may be better option than a polymer based commercial noise insulating product, an Experimental attempt has been made prepare a Noise insulation Panel made out of rice straw and Gypsum powder. In this investigation process and preparation of panels and the same panels are subjected to physical and sound insulation tests.
KEYWORDS
Indian Standard
Gross Domestic Product
Universal Testing Machine

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I. INTRODUCTION

1.1 General

Globally, noise pollution has grown to be a significant issue. Noise pollution, commonly known as environmental noise or sound pollution, is the spread of noise having various impacts on human and animal behaviour. The industrialization of the world is the primary contributor to outdoor noise.

A better environment and a more flexible lifestyle are becoming more and more in demand. A pleasing environment can be created utilizing a variety of methods that use different materials. One method is to reduce the noise. To reduce the noise levels in a room or other enclosed workspace, noise insulator materials are utilized. Therefore, the rice straw and gypsum powder materials that can reduce the noise.

Most of the developed countries use practical techniques to minimize the nuisance such as barrier walls, duct silencers, sound proof curtains, sound enclosures for industrial machinery and other similar noise control treatments that are installed near the source to effectively reduce the sound level. However, India has not yet yielded much into this issue as noise reduction methods are costly. Therefore, it is necessary to find out cost effective solution to control industrial noise.

1.2 Objectives

- Noise has a significant impact on human life, and Nuisance to the Environment, is a risk in today's human beings and animals.
- The main goal is to use agro waste and environmentally friendly material that may be used as an alternative noise insulator.
- It is proposed to create a composite Agro waste Panel for noise insulation. I

- This low-cost product could pave the way for a wide range of agricultural waste to be used in the construction of agro waste panels.

II. MATERIALS USED

This chapter explains the materials that were utilized to make the Sound Absorbing Panel. The procedures for preparation of agro waste products and developing a noise reduction panel.

2.1 Materials

2.1.1 Rice Straw:

- The presence of wax nature on the outer surface of straw prevents water or moisture from passing through.
- It is light in weight due to the voids present.
- It has a thermal resistance in nature.

Figure 2.1 and 2.2 Rice Straw

2.1.2 Gypsum:

Gypsum is a commonly used construction material, particularly in interior design. The properties and products of gypsum, which can be utilised as a construction material. It is widely used in the construction as non-load bearing partition walls and false ceilings. Gypsum can also be used on the job site in the form of plaster. It is available in the market as a prefabricated board. Gypsum colour ranges from white to grey and can be found in the earth's crust. The specific gravity of the gypsum is 2.8

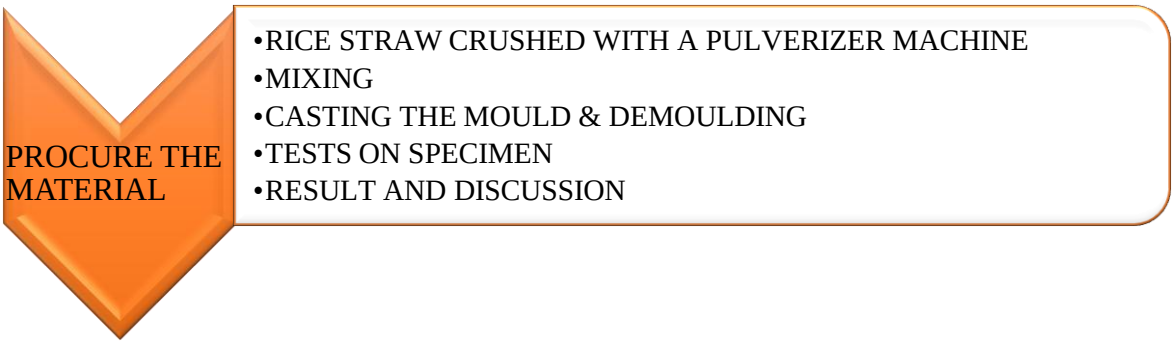
2.1.3 Water:

Water is extremely crucial in concrete since this supports in the chemical interaction with the gypsum. The water used for gypsum material mixing should be free of salts, clean, and free of acids, alkalis, and other damaging elements, as well as being portable**.**

The pH value of water is 6

III. EXPERIMENTAL METHODOLOGY AND INVESTIGATION

3.1 Methodology



3.2 Steps involved in the preparation of panel:

- Rice straw is gathered from a agriculture field.
- Rice Straw is crushed from Pulverizer.
- Gypsum Bag is obtained.
- Sieve the rice straw using (1.18 mm, 600 micron, 300 micron, and 150 micron sieves.
- Mix the rice straw (600 micron), gypsum and water.
- Add 5% of rice straw of (600 micron) sieve to the gypsum and mix with water.

Figure 3.1 Rice Straw (600 micron) Figure 3.2 Panel Casting

- Take (1'3"x1'3") feet mould. Fill the mould with the mix material and compact it evenly.
- Allow 30-40 minutes for it to dry before removing it from the mould.

Figure 3.3 Panel after Oven Dried

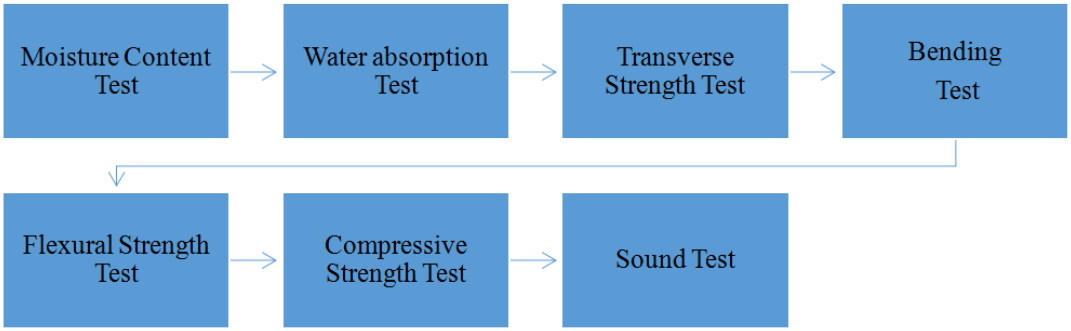
- Place the panel in the oven for 24 hours at 108°C.
- Repeat the casting process for rice straw of 300 micron and 150 micron sieve.
- Then examine the panel's strength, comparing the panel's test result to all the sieve size of the material which is more effective, strength.
- For various sizes (2'x2') feet and (1'x1') feet, repeat the casting procedure for (600 micron) sieve.
- Examine the test once the casting is complete.

Mix Design

Table 3.1 Mix Design of specimens

Specimen	Size	Rice Straw (gm)	Gypsum (Kg)	Water (ml)
Panel	1'x1' feet	62.5	1.250	1000
Panel	1'3"x1'3" feet	166.64	3333.34	2788
Panel	2'x2' feet	37	740	610
Cube	70x70x70mm	18	372	200
Flexural	160x40x40mm	12.8	256	175
Bending	250x18x18mm	5.2	104.8	80

3.3 Method of testing:



IV. RESULT AND DISCUSSION

The section contains the findings of the conducted tests, discussions, the panel's strength, and a comparison of the results to published literature.

4.1 Moisture Content Test:

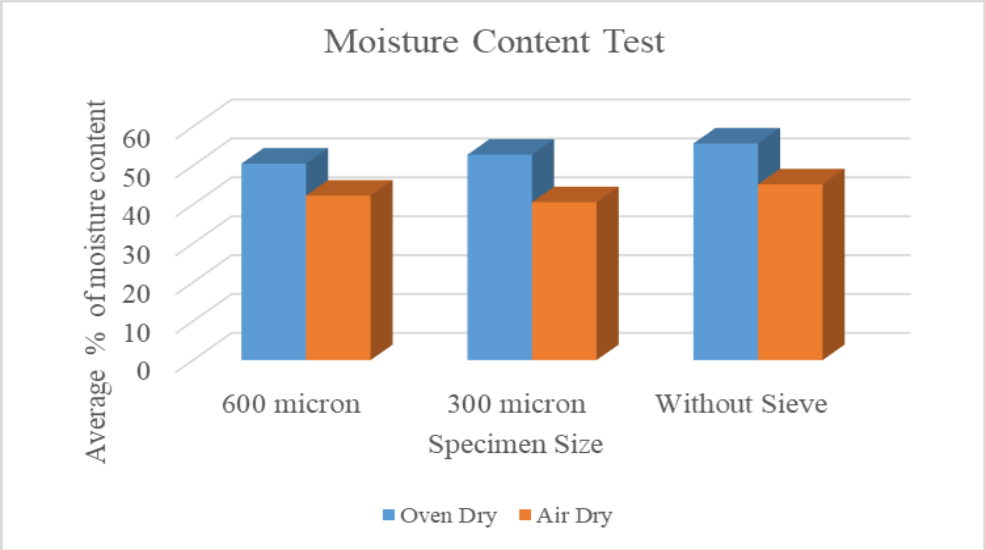
The procedure for conducting a water absorption test on gypsum plaster boards is covered by this standard, IS: 2542 (Part II/Sec 7) - 1981.

Table 4.1 (Oven Dry)

Sieve Size	Average (%)
600 micron	50.51
300 micron	52.82
Without Sieve	55.57

Table 4.2 (Air Dry)

Sieve Size	Average (%)
600 micron	42.3
300 micron	40.6
Without Sieve	45.2



4.2 Water absorption Test:

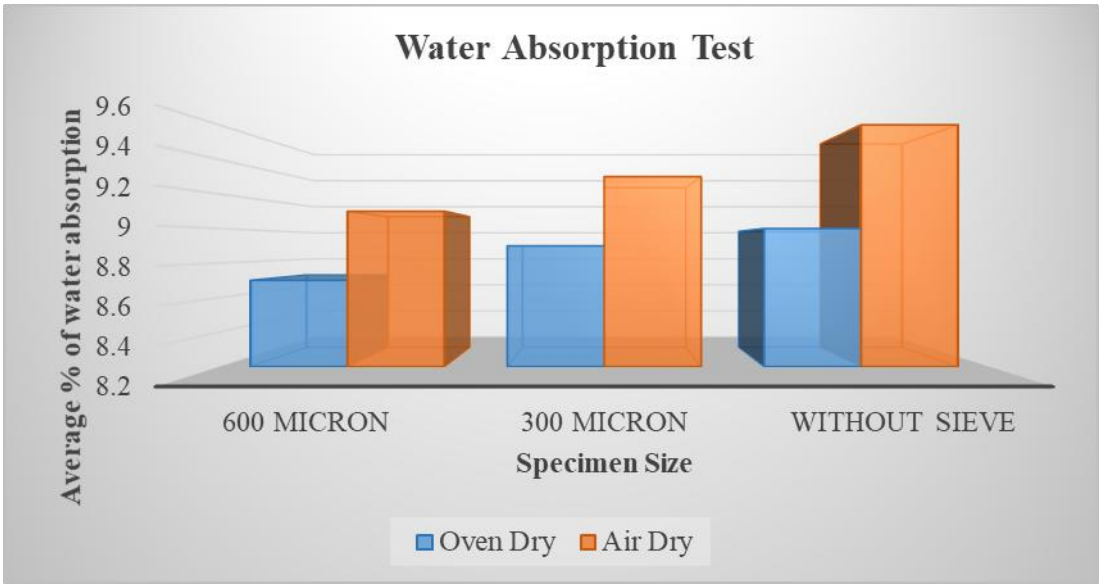
The procedure for conducting a water absorption test on gypsum plaster boards is covered by the standard, IS: 2542 (Part II/Sec 7) - 1981.

Table 4.3 (Oven Dry)

Sieve Size	Average (%)
600 micron	8.7
300 micron	8.9
Without Sieve	9

Table 4.4 (Air Dry)

Sieve Size	Average (%)
600 micron	9.1
300 micron	9.3
Without Sieve	9.6

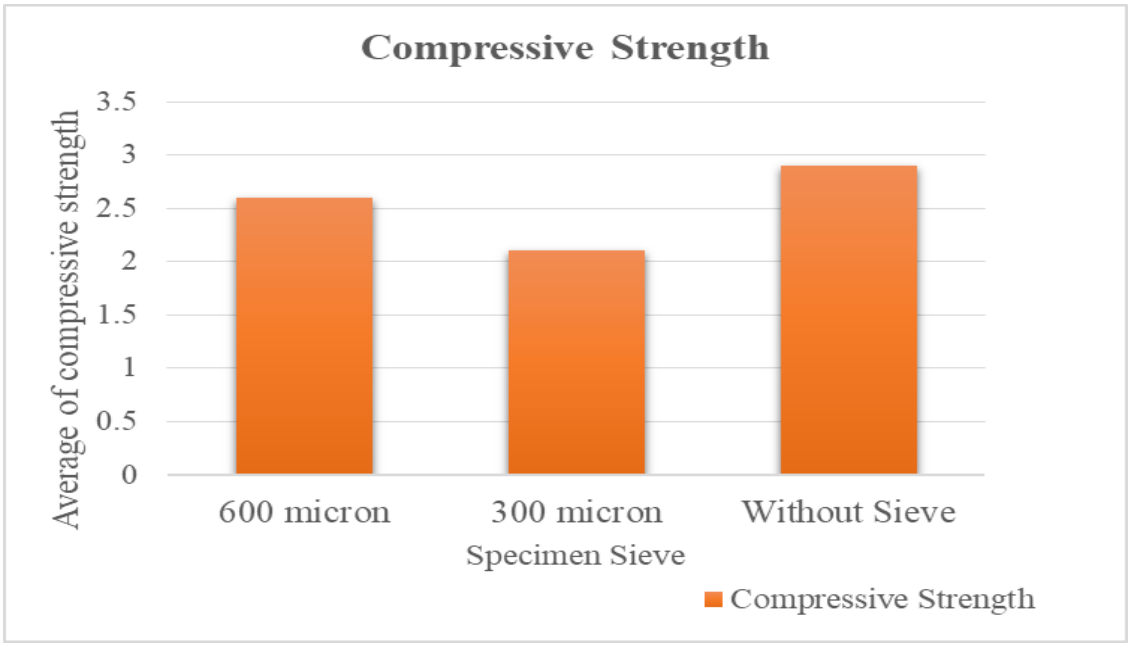


4.3Compressive Strength Test:

The standard IS: 2542 (Part II/Sec 7) – 1981 covers the method of carrying out compressive strength on gypsum products. 4 cubes of 70x70x70mm are casted and tested. While inside the compression device, the cubes are loaded equally throughout their whole surface at a rate of 140 kg/cm2/min while being applied without shock

Table 4.5 Compressive Strength of cube

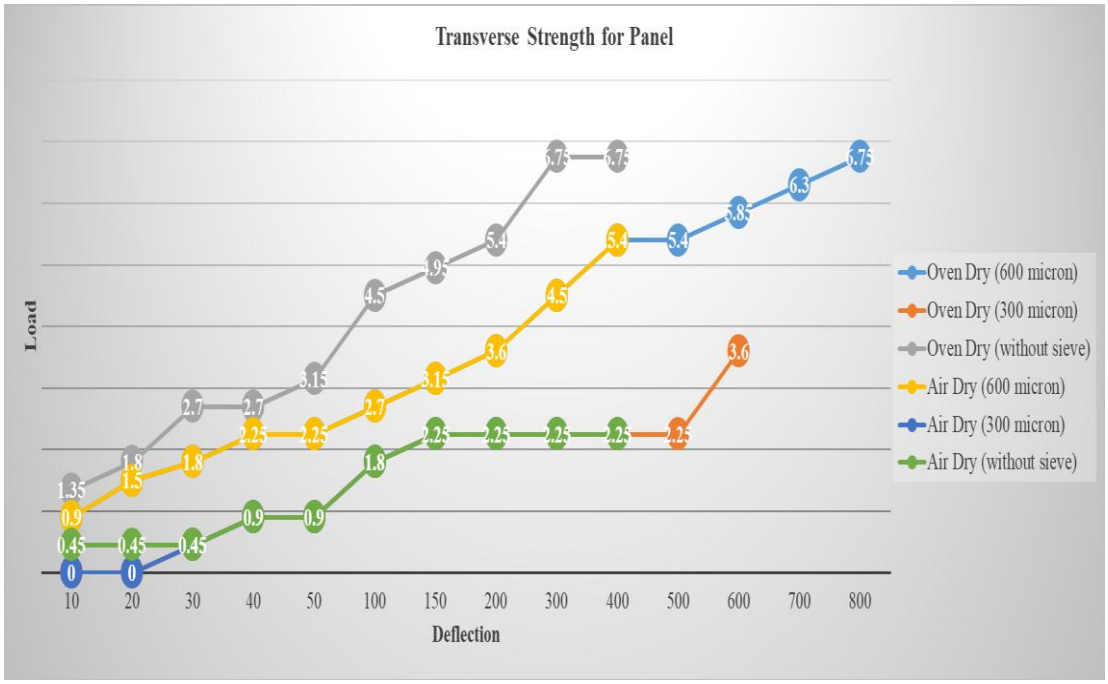
Sieve Size	Average of Compressive Strength (N/mm^2)
600 micron	2.6
300 micron	2.1
Without Sieve	2.9



4.4 Transverse Strength Test:

The standard IS: 2542 (Part II/Sec 7) – 1981 covers the method of carrying out transverse strength on gypsum panel.

- The specimen size is 1'x1' feet and oven drying, the sample is examined. The average breaking load of the specimen (600 micron) is 6.75 N/mm^2, (300 micron) is 3.6 N/mm^2 and for mix specimen is 6.75 N/mm^2.
- The specimen size is 1'x1' feet and after air drying, the sample is examined. The average breaking load of the specimen (600 micron) is 5.4 N/mm^2, (300 micron) is 2.25 N/mm^2 and for mix specimen is 2.25 N/mm^2.

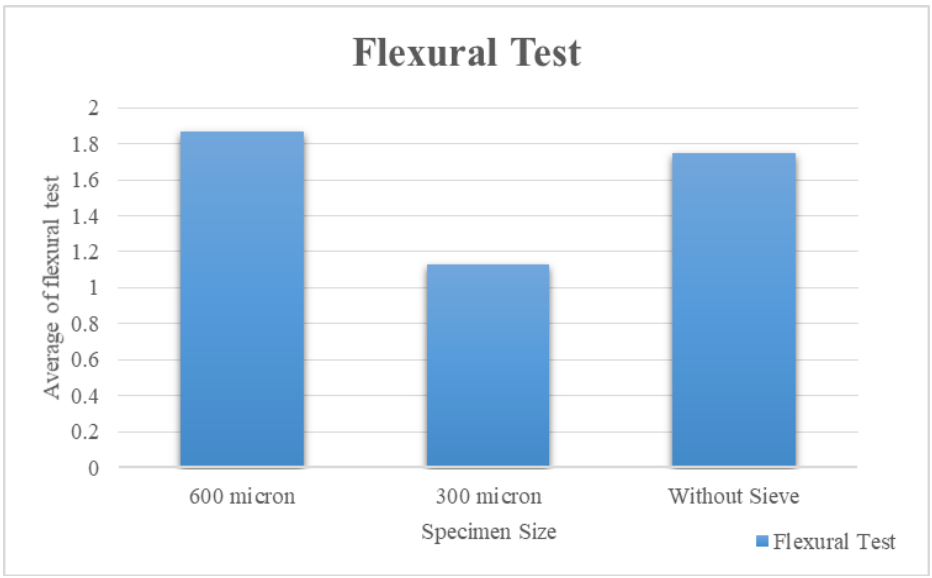


4.5 Flexural Strength Test:

Flexural testing is used to determine how flex or bending a material is. A sample is placed between the locations in this test, which is also known as a transverse test. The specimen is 160x40x40mm in size.

Table 4.6 Flexural Strength

Sieve Size	Average of Flexural Strength (N/mm^2)
600 micron	1.87
300 micron	1.13
Without Sieve	1.75

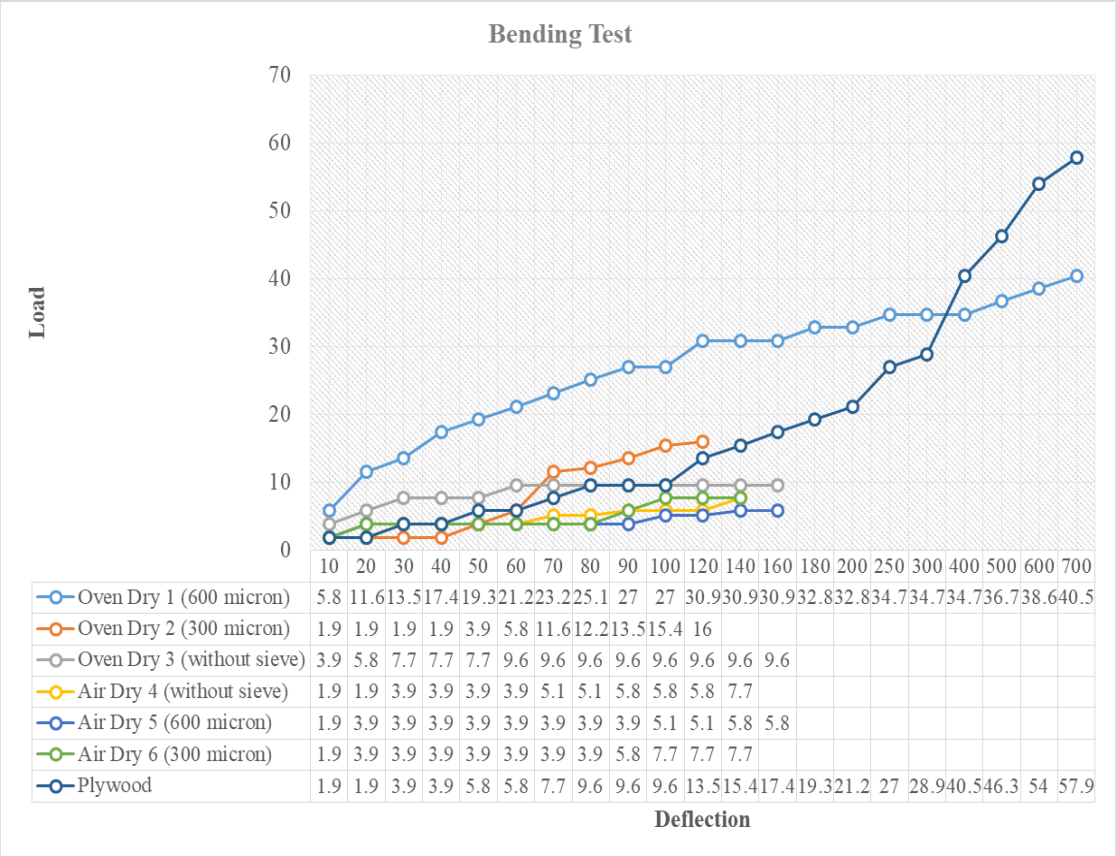


4.6 Bending Test:

For the test, we utilized plywood as a comparison. The standard IS: 1734 (Part 11) – 1983 specifies the test technique for determining the bending strength of plywood using the central loading method and the point load method.

The load must be applied through a suitable loading block for centre loading, with the movable head moving continuously during the test until a failure is shown.

- The specimen size is 250x18x18mm and oven drying, the sample is examined. The average breaking load of the specimen (600 micron) is 40.5 N/mm^2, (300 micron) is 16 N/mm^2 and for mix specimen is 9.6 N/mm^2.
- The specimen size is 250x18x18mm and oven drying, the sample is examined. The average breaking load of the specimen (600 micron) is 5.8 N/mm^2, (300 micron) is 7.7 N/mm^2 and for mix specimen is 7.7 N/mm^2.
- The average breaking load of the plywood specimen is 57.9 N/mm^2.



Deflection	10	20	30	40	50	60	70	80	90	100	120	140	160	180	200	250	300	400	500	600	700
Oven Dry 1 (600 micron)	5.8	11.6	13.5	17.4	19.3	21.2	23.2	25.1	27	27	30.9	30.9	30.9	32.8	32.8	34.7	34.7	34.7	36.7	38.6	40.5
Oven Dry 2 (300 micron)	1.9	1.9	1.9	1.9	3.9	5.8	11.6	12.2	13.5	15.4	16										
Oven Dry 3 (without sieve)	3.9	5.8	7.7	7.7	7.7	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6								
Air Dry 4 (without sieve)	1.9	1.9	3.9	3.9	3.9	3.9	5.1	5.1	5.8	5.8	5.8	7.7									
Air Dry 5 (600 micron)	1.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	5.1	5.1	5.8	5.8								
Air Dry 6 (300 micron)	1.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	5.8	7.7	7.7	7.7									
Plywood	1.9	1.9	3.9	3.9	5.8	5.8	7.7	9.6	9.6	9.6	13.5	15.4	17.4	19.3	21.2	27	28.9	40.5	46.3	54	57.9

4.7 Sound Test:

Reducing noise is one method to soundproof an area. Dense foam is a common substance used for this. Foam and other soft materials absorb sound, which lessens it since sound goes directly through the soft surface of the substance. This approach is carried out with the aid of a decibel metre, and the result is displayed automatically. For this test, a 1'x1' feet 24 panel and 6mm toughened glass was used.

Temperature of the room = 27°C

Humidity of the room = 78 %

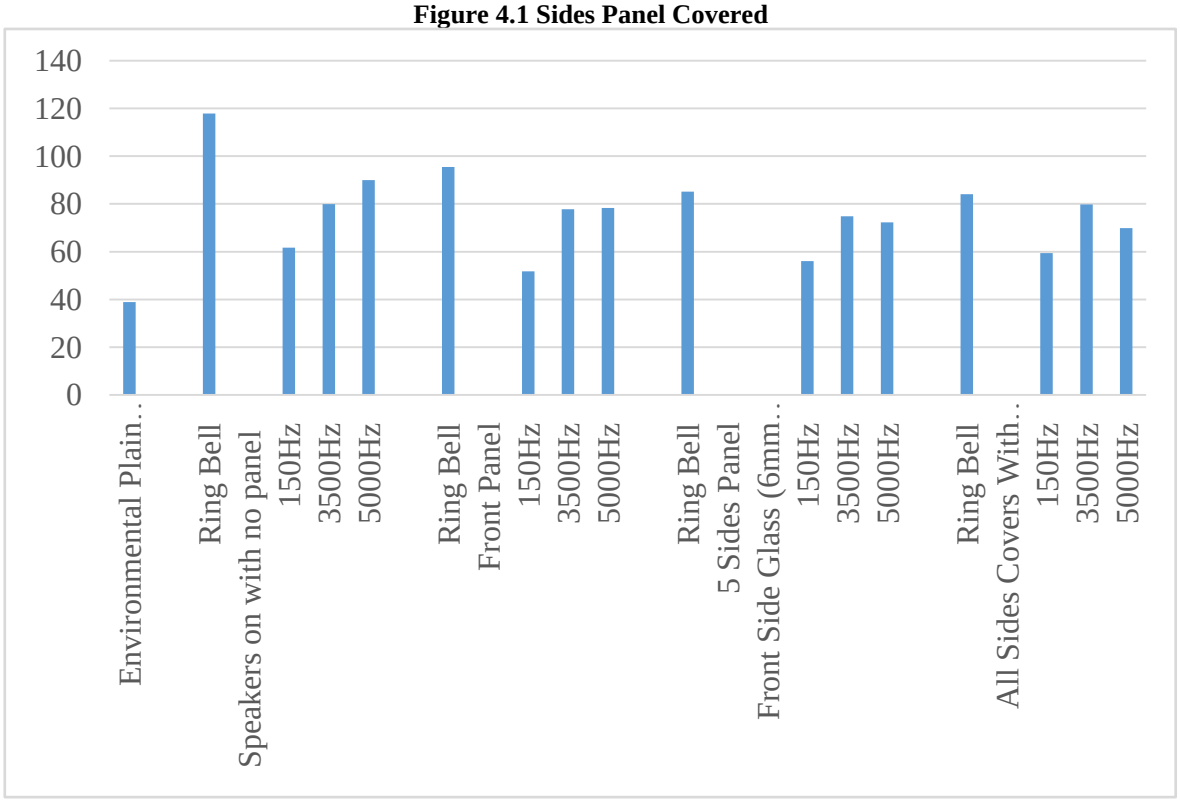
Height of the speaker = 1 feet

Distance of Decibel meter =1 meter

Table 4.7 Sound Test for Panel

Sl No	Particular	Average
1	Environmental Plain Room Condition	38.86
2	Ring Bell	117.9
	Speakers on with no panel	
	150Hz	61.67
	3500Hz	79.9
	5000Hz	89.93
	Ring Bell	95.5
	Front Panel	
3	150Hz	51.7
	3500Hz	77.8
	5000Hz	78.3
4	Ring Bell	85.2
	5 Sides Panel Front Side Glass (6mm toughened)	
	150Hz	56
	3500Hz	74.8
	5000Hz	72.3
5	Ring Bell	84.1
	All Sides Covers With Panel	
	150Hz	59.4
	3500Hz	79.73
	5000Hz	69.8

Figure 4.1 Sides Panel Covered



V. CONCLUSION

From the above experiment test conducted the mix having 5% rice straw, 95% gypsum, 80% water has helded better performance than the other mixes casted. The mix as shown better result in moisture content up to 51.67 % and a water absorption rate is 8.7 percent. The specimen has a transverse strength of 6.75 N/mm^2 and a bending strength up to 40.5 N/mm^2. The noise level is 90.2 dB, but after the panel is in place, the noise level reading drops to 77.6 dB. Hence, this mix can be cast and be used in interiors of a building for better noise insulation.

To reduce the noise that is being produced unnecessarily by utilizing noise reduction. The conduction an experiment using agricultural waste as a material and found that it is an effective noise reduction that can be produced with minimum cost. This initiative is a solution to noise pollution, one of today's issue. The best use for this product is as a noise-reduction panel in the building and construction industry. This study demonstrated the use of an agricultural material, such as rice straw, as a modified material and design for an environmentally friendly product.

5.1 Future scope of work

❖ Furthermore new agriculture waste materials may be explored for cast of similar gypsum panels having higher rate of agri waste having better strength properties.

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